

US011686913B2

(12) **United States Patent**  
**Wimmer**

(10) **Patent No.:** **US 11,686,913 B2**  
(45) **Date of Patent:** **Jun. 27, 2023**

(54) **FIBER OPTIC CABLE ASSEMBLIES AND CONNECTOR ASSEMBLIES HAVING A CRIMP RING AND CRIMP BODY AND METHODS OF FABRICATING THE SAME**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **17/527,291**

(22) Filed: **Nov. 16, 2021**

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(65) **Prior Publication Data**

US 2022/0171147 A1 Jun. 2, 2022

**Related U.S. Application Data**

(60) Provisional application No. 63/119,060, filed on Nov. 30, 2020.

(51) **Int. Cl.**  
**G02B 6/44** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **G02B 6/4471** (2013.01); **G02B 6/4432** (2013.01)

(58) **Field of Classification Search**  
CPC ..... G02B 6/4432; G02B 6/4471  
See application file for complete search history.

(57) **ABSTRACT**

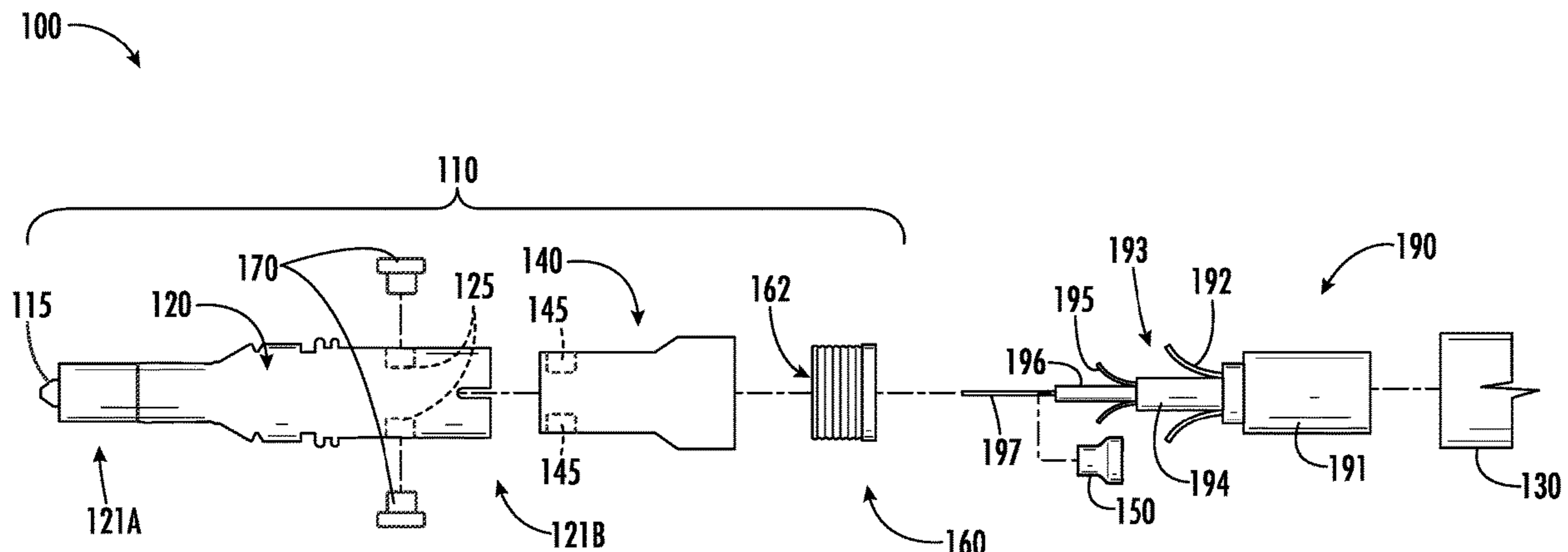
Fiber optic cable assemblies and methods of fabrication are disclosed. In one embodiment, a fiber optic cable assembly includes a fiber optic cable and a connector assembly. The connector assembly includes a connector body having a body passageway and a body aperture. The connector assembly further includes a crimp ring, a crimp body and a locking element. The crimp ring includes a first end, a second end, a crimp ring passageway, and a crimp ring aperture. The crimp body includes a crimp body passageway and one or more crimp features. The crimp body is crimped to the cable jacket such that the strength members wrap around the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body. The locking element is disposed within the body aperture and the crimp ring aperture.

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**27 Claims, 4 Drawing Sheets**



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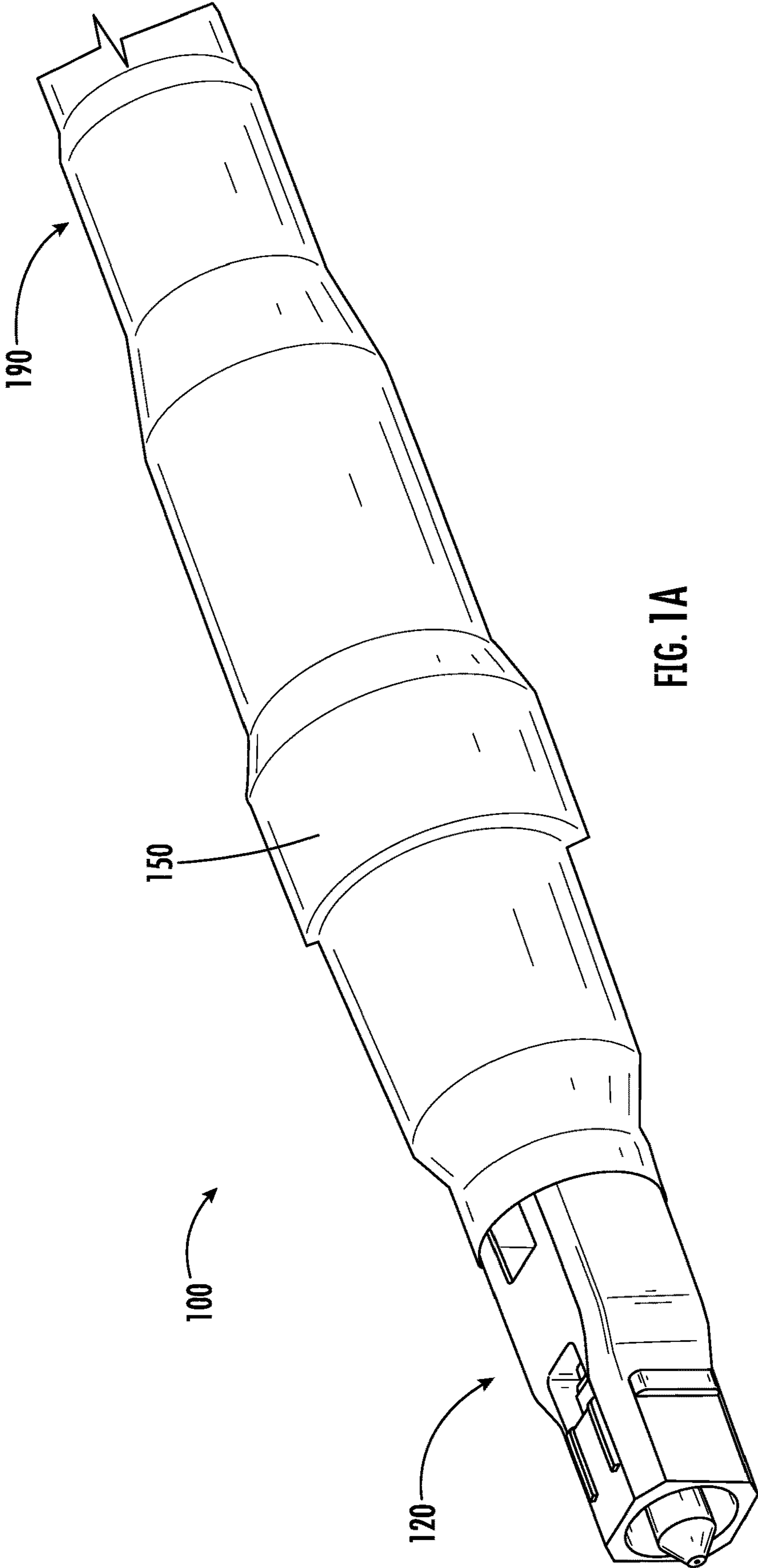


FIG. 1A







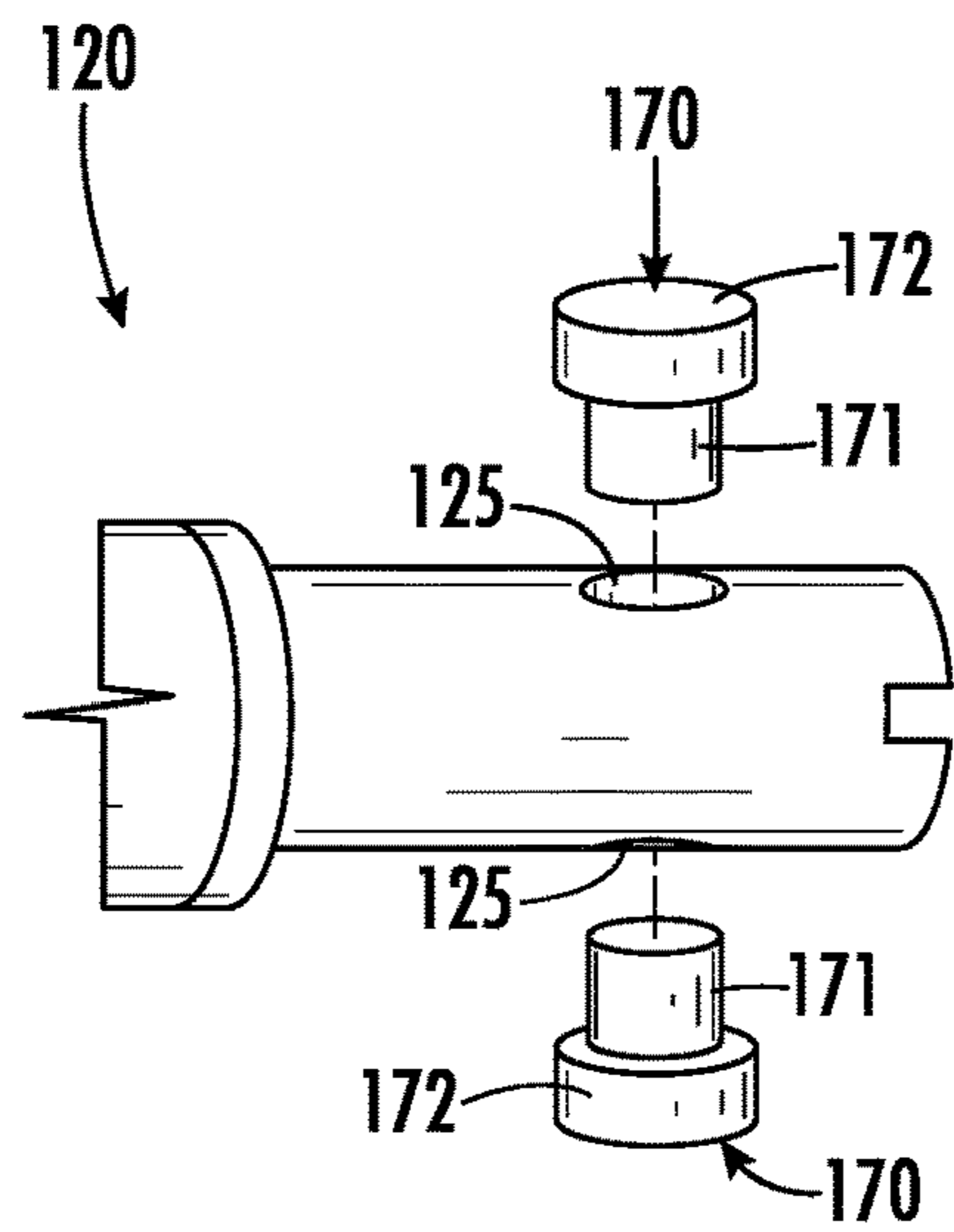


FIG. 2

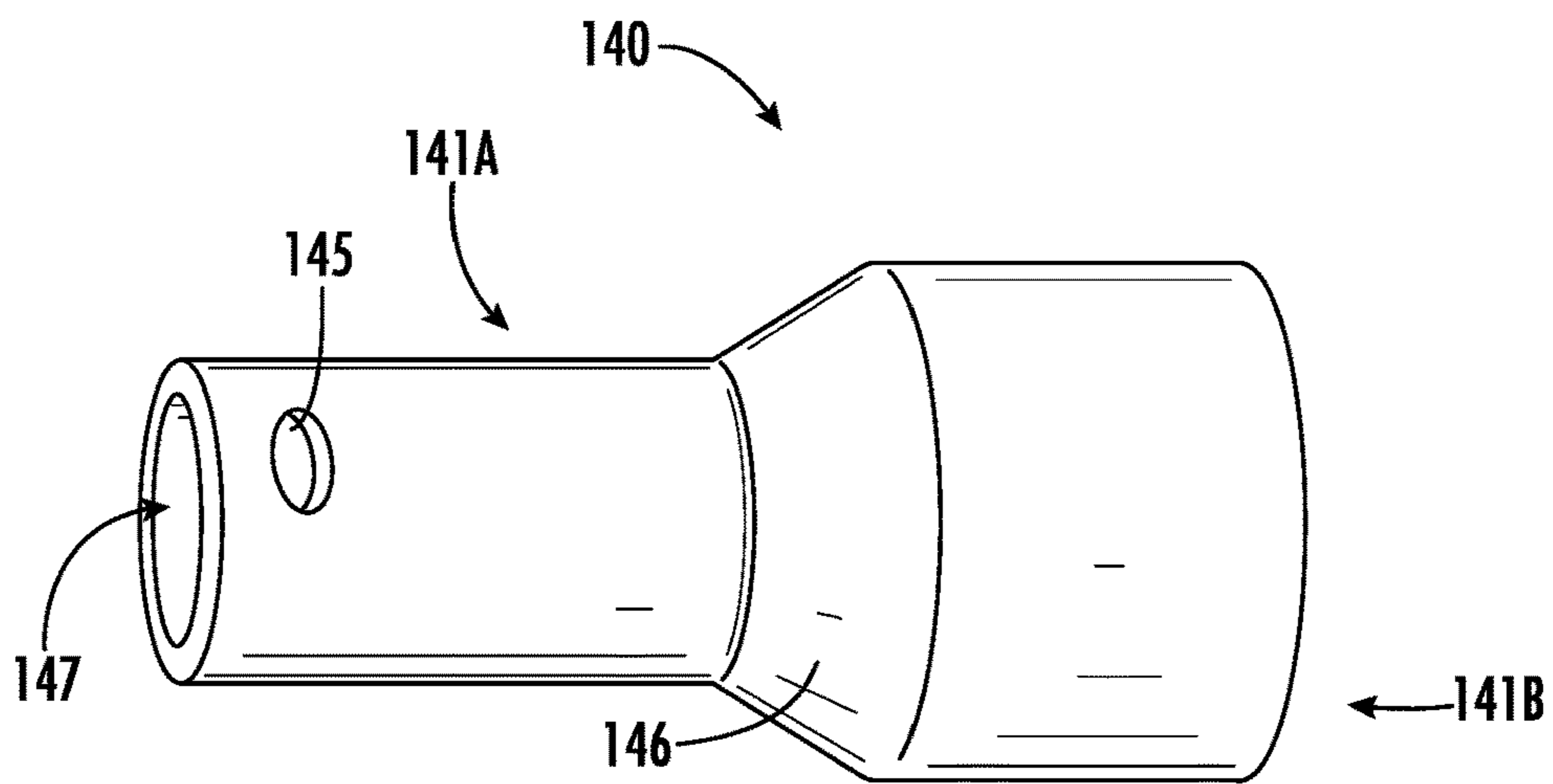


FIG. 3

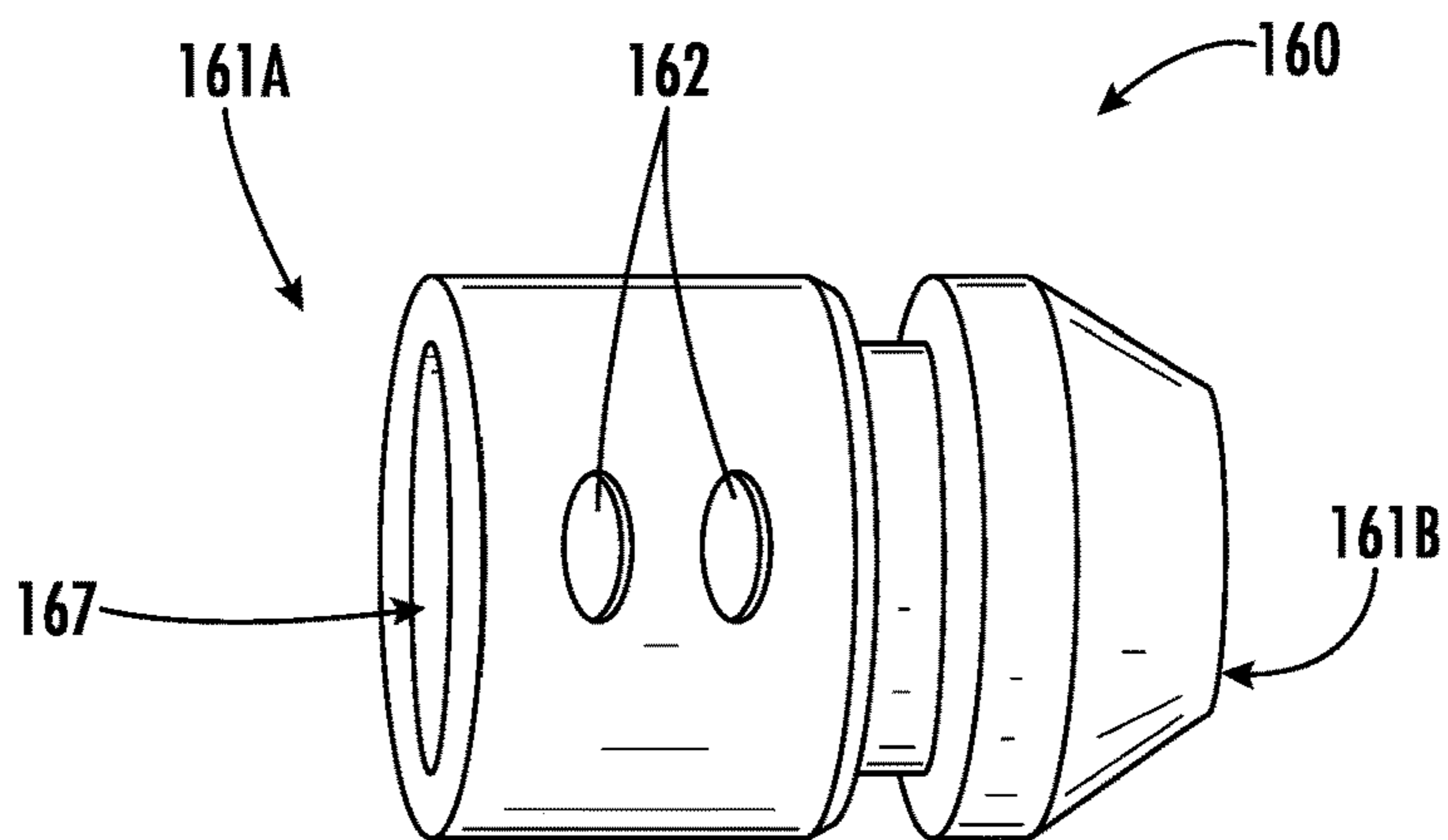


FIG. 4



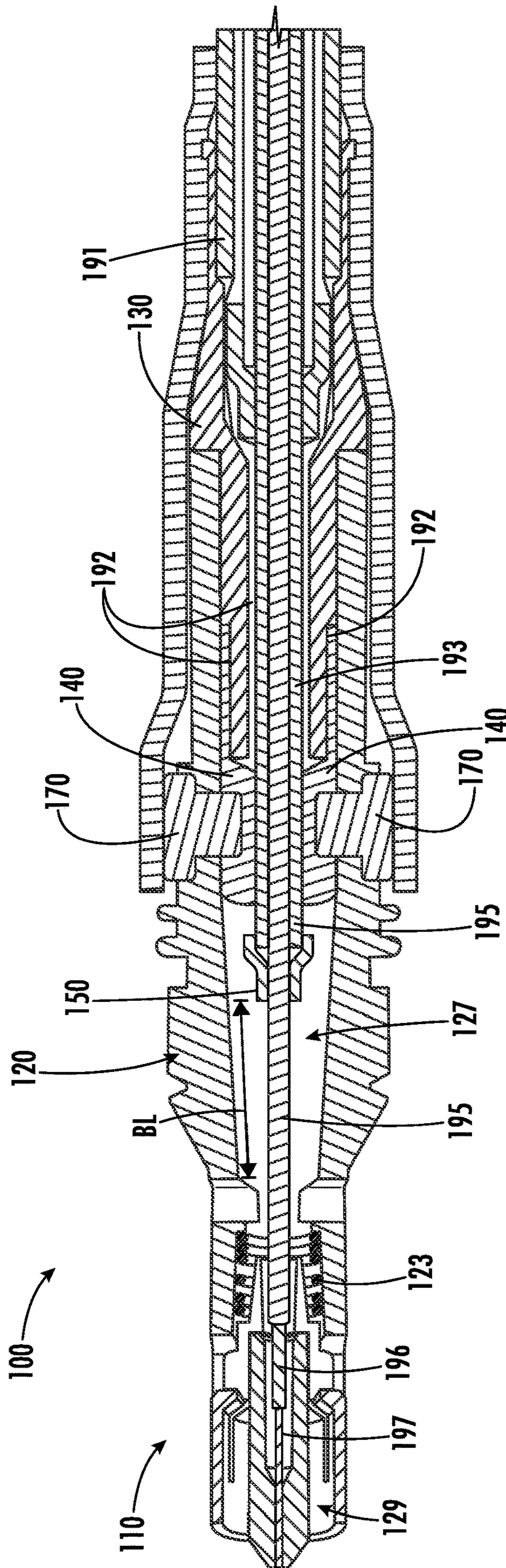


FIG. 5



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**FIBER OPTIC CABLE ASSEMBLIES AND  
CONNECTOR ASSEMBLIES HAVING A  
CRIMP RING AND CRIMP BODY AND  
METHODS OF FABRICATING THE SAME**

CROSS-REFERENCES TO RELATED  
APPLICATIONS

This application claims the benefit of priority of U.S. Provisional Application Ser. No. 63/119,060 filed on Nov. 30, 2020, the content of which is relied upon and incorporated herein by reference in its entirety.

FIELD

The disclosure is directed to fiber optic connectors and fiber optic cable assemblies and, more particularly, fiber optic connectors and fiber optic cable assemblies having a crimp ring and a crimp body to secure a fiber optic connector to a fiber optic cable.

BACKGROUND

Optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. As bandwidth demands increase, optical fiber is migrating deeper into communication networks such as in fiber to the premises applications such as FTTx, 5G and the like. As optical fiber extends deeper into communication networks there exist a need for building more complex and flexible fiber optic networks using fiber optic connectors in a quick and easy manner.

Fiber optic connectors were developed for making plug and play optical connections at links or devices in the communication network such as terminals, cabinets, patch panels, and like. The fiber optic connectors allow the distribution of optical signals within an optical network and provide the flexibility of locating the devices in convenient locations for efficient network design and deployment and also deferring connectivity and the associated expense until needed in the communication network.

Outdoor fiber optic cable assemblies, such as those including dual drop fiber cables, have a hardened connector on at least one end of the fiber optic cable. The hardened connector should be securely attached to the fiber optic cable in a manner that provides reliable sealing and strain relief. However, in some cases it may be desired to attached a certain type of hardened connector to a fiber optic cable that was not designed to be attached to certain hardened connector.

Consequently, there exists an unresolved need for fiber optic connector designs that enable hardened connectors to be securely attached to fiber optic cables.

SUMMARY

The disclosure is directed to connector assemblies and fiber optic cable assemblies. The embodiments described herein are directed to connector assemblies and fiber optic cable assemblies including a crimp ring and a crimp body to securely attach the connector assembly to a fiber optic cable. Embodiments may be utilized to attach a connector to a type of fiber optic cable that it was not designed to be attached to. More particularly, strength members of the fiber optic cable are pulled back over a crimp body that is disposed on the cable jacket of the fiber optic cable. A crimp ring is then crimped over the strength members and the crimp body to

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secure the crimp ring to the strength members and the crimp body. At least one locking element is used to secure a connector body of the connector to the crimp ring. Heat shrink elements are used to provide sealing.

5 One aspect of the disclosure is directed to a fiber optic cable assembly including a fiber optic cable and a connector assembly. The fiber optic cable has an optical fiber, strength members and a cable jacket. The connector assembly includes a connector body having a first end, a second end, 10 a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The connector assembly further includes a crimp ring, a crimp body and at least one locking element. The crimp ring includes a first end, a second end, a crimp ring passageway 15 extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end has a smaller diameter than the second end. The crimp body includes a first end, a second end, a crimp body passageway 20 extending between the first end and the second end, and one or more crimp features. The fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway. The crimp body is crimped to the cable jacket such that the strength members wrap 25 around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end 30 of the crimp ring is disposed within the body passageway. The at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

Another aspect of the disclosure is directed to including a 35 dual drop fiber optic cable and a connector assembly. The dual drop fiber optic cable has an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members. The connector assembly includes a connector body having a first end, a 40 second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The connector assembly further includes a crimp ring, a crimp body, at least one locking element, a first heat shrink element, and a second heat shrink element. The 45 crimp ring includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end has a smaller diameter than the second end. The 50 crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway. The crimp body 55 is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end of the crimp ring is disposed within the body passageway and the sub-unit is disposed within the crimp ring passageway. The at least one locking element is disposed within the at least one body aperture and the at least 60 one crimp ring aperture to secure the crimp ring to the connector body. The first heat shrink element is disposed about the connector body, the second end of the crimp ring,



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and the cable jacket. The second heat shrink element surrounds a tight buffer surrounding the optical fiber that is within the sub-unit and an sub-unit jacket of the sub-unit.

Yet another aspect of the disclosure is directed to a connector assembly including a connector body, a crimp ring, a crimp body, and at least one locking element. The connector body includes a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The crimp ring includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end of the crimp ring has a smaller diameter than the second end. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end of the crimp ring is disposed within the body passageway. The at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

Yet another aspect of the disclosure is directed to a method of fabricating a fiber optic cable assembly. The method includes preparing a dual drop fiber optic cable having an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members. The sub-unit includes a tight buffer surrounding the optical fiber, inner strength members surrounding the tight buffer, and a sub-unit jacket surrounding the inner strength members. The method further includes disposing a first heat shrink element on the cable jacket, disposing a second heat shrink element on a portion of the sub-unit jacket and a portion of the tight buffer and providing heat to the second heat shrink element, and disposing a crimp body on the cable jacket. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The method further includes pulling back at least a portion of the strength members so that they are adjacent the crimp body, and disposing a crimp ring on the crimp body. The crimp body includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end of the crimp ring has a smaller diameter than the second end of the crimp ring. The sub-unit is disposed within crimp ring passageway at the first end and the crimp body is disposed within the crimp ring passageway at the second end. The method also includes applying a crimping force to crimp the crimp ring to the crimp body at the one or more crimp features, and inserting the dual drop fiber optic cable and the crimp ring into a body passageway of a connector body. The connector body includes a first end, a second end, the body passageway extending from the first end to the second end, and at least one body aperture at the second end. The method also includes aligning the at least one body aperture of the connector body with the at least one crimp ring aperture of the crimp ring, and inserting at least one locking element into the at least one body aperture of the connector body and the at least one crimp ring aperture of the crimp ring to secure the connector body to the crimp ring. The method

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further includes applying heat to the first heat shrink element to secure the connector body and the crimp ring to the fiber optic cable.

Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the same as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments that are intended to provide an overview or framework for understanding the nature and character of the claims. The accompanying drawings are included to provide a further understanding of the disclosure, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments and together with the description serve to explain the principles and operation.

#### BRIEF DESCRIPTION OF THE FIGURES

FIG. 1A is a perspective view of an example fiber optic cable assembly according to one or more embodiments described and illustrated herein;

FIG. 1B is an exploded view of the example fiber optic cable assembly according to one or more embodiments described and illustrated herein;

FIG. 2 is a perspective view of an example connector body and two locking elements according to one or more embodiments described and illustrated herein;

FIG. 3 is a perspective view of an example crimp ring according to one or more embodiments described and illustrated herein;

FIG. 4 is a perspective view of an example crimp body according to one or more embodiments described and illustrated herein; and

FIG. 5 is a cross section view of an example fiber optic cable assembly according to one or more embodiments described and illustrated herein.

#### DETAILED DESCRIPTION

Reference will now be made in detail to the embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, like reference numbers will be used to refer to like components or parts.

The concepts disclosed herein are related to connector assemblies and fiber optic cable assemblies including a crimp ring and a crimp body to securely attach the connector assembly to a fiber optic cable. Embodiments may be utilized to attach a connector assembly to a type of fiber optic cable that it was not designed to be attached to. As a non-limiting example, the connector may be a Evolv hardened optical connector sold by Corning Optical Communications of Hickory, N.C., and the fiber optic cable may be a dual drop fiber optic cable having a sub-unit surrounded by strength members and a cable jacket.

More particularly, strength members of the fiber optic cable are pulled back over a crimp body that is disposed on the cable jacket of the fiber optic cable. A crimp ring is then crimped over the strength members and the crimp body to secure the crimp ring to the strength members and the crimp body. At least one locking element is used to secure a connector body of the connector to the crimp ring. Heat shrink elements are used to provide environmental sealing.



Various embodiments of connectors, fiber optic cable assemblies, and methods of fabricating the same are described in detail below.

FIGS. 1A and 1B depict an example fiber optic cable assembly 100 comprising a connector assembly 110 coupled to an end of a fiber optic cable 190. FIG. 1A illustrates the fiber optic cable assembly 100 in an assembled state while FIG. 1B is an exploded view of the fiber optic cable assembly 100. The connector assembly 110 generally comprises, among other components, a connector body 120, a crimp ring 140, a crimp body 160, a first heat shrink element 130, and a second heat shrink element.

In the illustrated embodiment, the fiber optic cable 190 comprises a dual drop fiber optic cable. Referring to FIG. 1B, the fiber optic cable 190 is illustrated as a prepared dual drop fiber optic cable that is ready to receive the fiber optic connector 110. That is, various layers of the fiber optic cable 190 have been stripped to receive the connector assembly 110. The example fiber optic cable 190 includes a cable jacket 191, strength members 192, and a sub-unit 193. The sub-unit 193 comprises a sub-unit jacket 194, inner strength members 195, a tight buffer 196, and an optical fiber 197.

The optical fiber 197 may include a core and a cladding to guide light by total internal reflection. The core and cladding are not illustrated in FIG. 1B, but together define the optical fiber 197 and may comprise glass (e.g., germanium-doped silica). The tight buffer 196 surrounds the optical fiber 197 to protect the optical fiber 197 from the environment and mechanical loads. As a non-limiting example, the tight buffer 196 may comprise a primary coating, and a secondary coating that surrounds the primary coating. The primary coating may be an acrylic polymer or the like. The secondary coating may comprise polyvinyl chloride (PVC), polyurethane, polyolefin, or the like.

The inner strength members 195 are disposed around the tight buffer 196 to provide mechanical strength to the fiber optic cable 190. The inner strength members 195 may be any suitable type of material, such as rigid glass-reinforced plastic (GRPs) or tensile yarns such as aramid, fiberglass, Kevlar® or the like that are flexible and provide tensile strength. Surrounding the inner strength members 195 is a sub-unit jacket 194. The material of the sub-unit jacket 194 may include, but is not limited to, polyvinyl chloride (PVC), polyethylene (PE), a UV curable resin (e.g. acrylate), or a fluoro-compound.

Strength members 192 are disposed around the sub-unit 193 to provide additional mechanical strength to the fiber optic cable 190. The inner strength members 195 may be any suitable type of material, such as GRPs or flexible yarns such as aramid, fiberglass, Kevlar® or the like. The cable jacket 191 surround the strength members 192. Non-limiting materials for the cable jacket 111 include PVC, polyethylene PE, a UV curable resin (e.g. acrylate), or a fluoro-compound.

The connector body 120 may take on any configuration. In the embodiment shown by FIGS. 1A and 1B, the connector body 120 is configured as a hardened SC connector with a defined single fiber connection interface. The connector body 120 generally comprises a first end 121A, a second end 121B and a body passageway 127 (FIG. 5) between the first end 121A and the second end 121B. The second end 121B of the connector body 120 includes at least one body aperture 125 that extends through the connector body 120 to the body passageway 127. The at least one body aperture 125 is sized for receiving at least one locking element 170 for securing the connector body 120 to the crimp ring 140, the crimp body 160 and the fiber optic cable 190, as described in more detail below. FIG. 2 is a partial

view of an example second end 121B of a connector body 120 having two body apertures 125 for receiving two locking elements 170. The at least one body aperture 125 may be formed by drilling one or more holes through the second end 121B, for example. As a non-limiting example, the locking elements 170 may be configured as locking buttons having an insertion portion 171 extending from a flange portion 172. The locking element 170 may have a symmetric or asymmetric design. However, it should be understood that the at least one locking element 170 may take on other configurations.

FIG. 3 illustrates an example crimp ring 140 as is shown in FIG. 1B. The crimp ring has a first end 141A, a second end 141B, a taper portion 146 between the first end 141A and the second end 141B, and a crimp ring passageway 147. The diameter of the first end 141A is smaller than the diameter of the second end 141B, and the diameter of the taper portion 146 increases in a direction from the first end 141A to the second end 141B. The crimp ring 140 further includes at least one crimp ring aperture 145 at the second end 141B. The at least one crimp ring aperture 145 is sized to also receive the at least one locking element 170 as described above with respect to the body aperture 125.

The crimp ring 140 is fabricated from a deformable material that can be crimped around the crimp body 160 as described below. As a non-limiting example, the crimp ring 140 may be made of a metal material.

FIG. 4 illustrates an example crimp body 160 as is shown in FIG. 1B. The crimp body 160 has a first end 161A, a second end 161B, and a crimp body passageway 167 between the first end 161A and the second end 161B. The crimp body 160 is configured to provide a rigid surface onto which the crimp ring 140 is crimped. In some embodiments, the outer surface of the first end 161A of the crimp body 160 includes one or more crimp features 162 to receive the second end 141B of the crimp ring 140 and improve the rigid coupling between the crimp ring 140 and the crimp body 160. The crimp features 162 may be indentations or piercings that are formed in the crimp body 160. The crimp features 162 may take on any geometry, such as circles, ovals, lines, and the like.

The first heat shrink element 130 and the second heat shrink 150 element may be made of any material capable of shrinking in size upon the application of heat. A non-limiting heat shrink material includes polyolefin. As described in more detail below, the first heat shrink element 130 provides sealing from the environment and also assists in securing the connector 110 to the fiber optic cable 190.

The at least one locking element 170, the crimp ring 140, the crimp body 160, and the first heat shrink element 130 cooperate to secure the connector 110 to the fiber optic cable 190. FIG. 5 illustrates a cross section view of an example connector 110 coupled to an example fiber optic cable 190. The fiber optic cable 190 is prepared such that a portion of the cable jacket 191 is stripped away to expose the sub-unit 193 and the strength members 192. The strength members 192 are trimmed such that at least some of them are pulled back in a direction away from the end of the fiber optic cable 190 receiving the connector 110.

The fiber optic cable is disposed through the crimp body passageway 167 of the crimp body 160 such that the crimp body 160 contacts the cable jacket 191. In some embodiments, an end face of the cable jacket 191 abuts an inner shoulder 168 of the crimp body 160 such that the inner shoulder 168 acts as a stop for the cable jacket 191. The strength members 192 are pulled back such that they are



disposed on the outer surface of the crimp body 160 and contact the crimp features 162.

The crimp ring 140 is disposed on the fiber optic cable 190 such that the exposed sub-unit 193 is within the crimp ring passageway 147 at the first end 141A, and the crimp body 160 is disposed within the crimp ring passageway 147 at the second end 141B. The second end 141B of the crimp ring 140 is crimped to the crimp body 160 such that the strength members 192 are between the crimp body 160 and the crimp ring 140, and within the crimp features 162 of the crimp body 160. The crimp ring 140 may be crimped to the strength members 192 and the crimp body 160 by a crimping tool, for example. Thus, the crimp ring 140 and the crimp body 160 are secured to the fiber optic cable 190 by way of the strength members 192.

In some embodiments, the second heat shrink element 150 is disposed around the interface of the tight buffer 196 and the sub-unit jacket 194 to secure the sub-unit strength members that are between the sub-unit jacket 194 and the tight buffer 196. Heat is applied to the second heat shrink element 150 to shrink it to the tight buffer 196 and the sub-unit jacket 194.

The first end 161A of the crimp ring 140 is disposed within body passageway 127 such that the at least one crimp ring aperture 145 of the crimp ring 140 with the at least one body aperture 125 of the connector body 120. The connector body 120 is secured to the crimp ring 140 (and thus the crimp body 160 and the fiber optic cable 190) by the at least one locking element 170 disposed within the at least one body aperture 125 and the at least one crimp ring aperture 145. The at least one body aperture 125, the at least one crimp ring aperture 145 and the at least one locking element 170 may be configured so that the at least one locking element 170 is non-removable from the at least one body aperture 125 and the at least one crimp ring aperture 145. For example, the components may mate by a non-removable press fit. In other embodiments, the at least one locking element 170 is removable from the at least one body aperture 125 and the at least one crimp ring aperture 145.

Still referring to FIG. 5, the first heat shrink element 130 is securely disposed over the second end 121B of the connector body 120, the second end 141B of the crimp ring 140, and a portion of the cable jacket 191. The first heat shrink element 130 may assist in maintaining the at least one locking element 170 in the at least one body aperture 125 and the at least one crimp ring aperture 145.

The optical fiber within the tight buffer 196 is within the body passageway 127. The body passageway 127 may be sized such that the tight buffer 196 portion of the fiber optic cable 190 may buckle along a buckle length BL. A ferrule assembly 129 is also disposed within the body passageway 127, and is biased by a spring element 123. The tight buffer 196 is stripped away at the very end of the fiber optic cable 190 to expose the optical fiber 197 (not shown in FIG. 5). The optical fiber 197 is inserted into, and maintained by, the ferrule assembly 129.

Thus, the connector 110 is secured to the fiber optic cable 190. Still referring to FIG. 5, one side of the insertion portion 171 of the at least one locking element 170 is used for transferring pull force and the other side is designed to deform during the press-fit to overcome tolerances. One locking element 170 may be used; however, at least two locking elements 170 may spread the load distribution more evenly into the connector body 120. Furthermore, the assembly process can be designed to press the locking element

contrary on one axis to each other. The correct orientation of the locking elements may be provided by jigs and fixtures, for example.

For cable pull force transfer, the locking element 170 is designed in relation with the connector body 120 to resist the maximum load before deforming. Due to the adhesive of the first heat sink element 130, the entire assembly becomes locked down at the connector end.

The crimp ring 140 is designed to grab the strength members 192 at its position on the fiber optic cable 190. Pull forces on the strength members 192 are directed from the fiber optic cable 190 without any freedom of movement for the strength members 192 (e.g., slack).

Strain relief is provided by compression of the cable jacket 191, which compresses the strength members 192. In some embodiments, only the tensile yarns such the Kevlar® of the strength members 192 is disposed between the crimp ring 140 and the crimp body 160. Thus, the glass yarn is cut short and not folded back. This may be done for space constraints. However, in some embodiments the glass yarn is folded back.

To resist cable bending, the complete cable end is inserted and supported in the connector 110. This reduces the strain relief length and minimizes connector length. This design reduces the generated moment on the connector body interface during a side pull of the fiber optic cable, and causes higher reliability.

To resist cable torsion, the crimp body is compressed with cable jacket 191, as well as the first heat shrink element 130. The two notches at the connector body 120 interact with the crimp body torsion wings. To resist pull load, several mechanisms work together to demarcate the fiber optic cable components relative to each other. The main pull force will be transferred by the strength members 192 through the crimp body 160. The at least one locking element 170 is designed to transfer the load from the crimp body 160 into the connector body 120. To strengthen the strength member crimp, a metal to metal crimp connection is designed by fabricating both the crimp ring 140 and the crimp body 160 from metal. As a non-limiting example, the crimp ring 140 and the crimp body 160 may be fabricated from an aluminum alloy. To avoid strength member slippage, the crimp ring 140 is locked on the crimp body 160. The bigger wall thickness of the front of the crimp body front causes the locking after crimping, due to the bigger outer radius of the crimp body 160. Further, the crimp features create further locking forces between the crimp ring 140 and the crimp body 160.

The first heat shrink element 130 supports pull force transfer on the cable jacket 191 in the connector body 120. The crimp body 160 grabs the cable jacket 191 and strain relieves it. To resist cable press-in force during installation, the design transfers the load from the jacket into the connector body. Sealing is provided by the first heat element 130. The adhesive inside the first heat shrink element 130 bond the cable jacket 191 and the connector body 120 to seal off any potential leak paths.

Embodiments are also directed to methods of fabricating a fiber optic cable assembly. Referring generally to FIGS. 1B and 5, the method first includes preparing a dual drop fiber optic cable. Preparing the dual drop fiber optic cable includes stripping a portion of the cable jacket 191 to expose strength members 192 and the sub-unit 193, trimming a portion of the strength members 192, stripping a portion of the sub-unit jacket 194 and the inner strength members 195 to expose the tight buffer 196, and stripping a portion of the tight buffer 196 to expose the optical fiber 197.



Next, the first heat shrink is disposed on the cable jacket **191**, and the second heat shrink element **150** is disposed on a portion of the sub-unit jacket **194** and a portion of the tight buffer **196**. Heat is applied to the second heat shrink element **150** to secure the inner strength members **195**. The crimp body **160** is disposed on the cable jacket **191**. The method further includes pulling back at least a portion of the strength members **192** so that they are adjacent the crimp body **160**.

Next, the crimp ring **140** is disposed on the crimp body **160** such that the first end **161A** of the crimp ring **140** surrounds the sub-unit **193**. The method includes applying a crimping force to crimp the crimp ring **140** to the crimp body **160** at the one or more crimp features **162**, which locks the strength members **192** in between the crimp ring **140** and the crimp body **160**. Then, the method includes inserting the dual drop fiber optic cable **190** and the crimp ring **140** into a body passageway **127** of a connector body **120**. The at least one body aperture **125** of the connector body **120** is aligned with the at least one crimp ring aperture **145** of the crimp ring **140**. The at least one locking element **170** is inserted into the at least one body aperture **125** of the connector body **120** and the at least one crimp ring aperture **145** of the crimp ring **140** to secure the connector body **120** to the crimp ring **140**. Then, heat is applied to the first heat shrink element **130** to secure the connector body **120** and the crimp ring **140** to the fiber optic cable **190**.

It should now be understood that embodiments of the present disclosure are directed to fiber optic cable assemblies having a connector assembly securely attached to a fiber optic cable assembly by use of a crimp ring and a crimp body. The strength members of the fiber optic cable are crimped between the crimp ring and the crimp body. Thus, the strength members are utilized to secure the crimp ring and the crimp body to the fiber optic cable. Additionally, at least one locking element is used to lock a connector body of the connector to the crimp ring, and a heat shrink element is used to provide sealing and strain relief functions.

Although the disclosure has been illustrated and described herein with reference to explanatory embodiments and specific examples thereof, it will be readily apparent to those of ordinary skill in the art that other embodiments and examples can perform similar functions and/or achieve like results. All such equivalent embodiments and examples are within the spirit and scope of the disclosure and are intended to be covered by the appended claims. It will also be apparent to those skilled in the art that various modifications and variations can be made to the concepts disclosed without departing from the spirit and scope of the same. Thus, it is intended that the present application cover the modifications and variations provided they come within the scope of the appended claims and their equivalents.

The invention claimed is:

**1.** A fiber optic cable assembly comprising:

a fiber optic cable comprising an optical fiber, strength members and a cable jacket; and

a connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features; and

at least one locking element;

wherein:

the fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway;

the crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket;

the second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

the first end of the crimp ring is disposed within the body passageway; and

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

**2.** The fiber optic cable assembly of claim **1**, further comprising a first heat shrink element disposed about the connector body, the second end of the crimp ring, and the cable jacket.

**3.** The fiber optic cable assembly of claim **2**, wherein the fiber optic cable further comprises a sub-unit that maintains the optical fiber and is surrounded by the strength members.

**4.** The fiber optic cable assembly of claim **3**, further comprising a second heat shrink surrounding a tight buffer surrounding the optical fiber that is within the sub-unit and a sub-unit jacket of the sub-unit.

**5.** The fiber optic cable assembly of claim **1**, wherein the one or more crimp features are one or more indentations in the crimp body.

**6.** The fiber optic cable assembly of claim **1**, wherein the body passageway comprises a buckle cavity.

**7.** The fiber optic cable assembly of claim **1**, wherein the at least one locking element comprise at least one locking button comprising an insertion portion and a flange portion.

**8.** The fiber optic cable assembly of claim **1**, wherein the strength members comprises glass yarn and tensile yarn.

**9.** The fiber optic cable assembly of claim **1**, further comprising a ferrule assembly disposed within the body passageway.

**10.** The fiber optic cable assembly of claim **1**, wherein: the at least one body aperture comprises a first body aperture and a second body aperture;

the at least one crimp ring aperture comprises a first crimp ring aperture and a second crimp ring aperture; and the at least one locking element comprises a first locking element and a second locking element.

**11.** A fiber optic cable assembly comprising:

a dual drop fiber optic cable comprising an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members;

a connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring



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aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features;

at least one locking element;

a first heat shrink element; and

a second heat shrink element;

wherein:

the dual drop fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway;

the crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket;

the second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

the first end of the crimp ring is disposed within the body passageway and the sub-unit is disposed within the crimp ring passageway;

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body;

the first heat shrink element disposed about the connector body, the second end of the crimp ring, and the cable jacket; and

the second heat shrink element surrounds a tight buffer surrounding the optical fiber that is within the sub-unit and a sub-unit jacket of the sub-unit.

**12.** The fiber optic cable assembly of claim **11**, wherein the one or more crimp features are one or more indentations in the crimp body.

**13.** The fiber optic cable assembly of claim **11**, wherein the body passageway comprises a buckle cavity.

**14.** The fiber optic cable assembly of claim **11**, wherein the at least one locking element comprise at least one locking button comprising an insertion portion and a flange portion.

**15.** The fiber optic cable assembly of claim **11**, wherein the strength members comprises glass yarn and tensile yarn.

**16.** The fiber optic cable assembly of claim **11**, further comprising a ferrule assembly disposed within the body passageway.

**17.** A connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features; and

at least one locking element;

wherein:

the second end of the crimp ring is configured to be crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

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the first end of the crimp ring is disposed within the body passageway; and

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

**18.** The connector assembly of claim **17**, wherein the one or more crimp features are one or more indentations in the crimp body.

**19.** The connector assembly of claim **17**, wherein the body passageway comprises a buckle cavity.

**20.** The connector assembly of claim **17**, wherein the at least one locking element comprises at least one locking button comprising an insertion portion and a flange portion.

**21.** A method of fabricating a fiber optic cable assembly, the method comprising:

preparing a dual drop fiber optic cable comprising an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members, wherein the sub-unit comprises a tight buffer surrounding the optical fiber, inner strength members surrounding the tight buffer, and a sub-unit jacket surrounding the inner strength members;

disposing a first heat shrink element on the cable jacket;

disposing a second heat shrink element on a portion of the sub-unit jacket and a portion of the tight buffer, and a providing heat to the second heat shrink element;

disposing a crimp body on the cable jacket, wherein the crimp body comprises a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features;

pulling back at least a portion of the strength members so that they are adjacent the crimp body;

disposing a crimp ring on the crimp body, wherein:

the crimp body comprises a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end; and

the sub-unit is disposed within the crimp ring passageway at the first end and the crimp body is disposed within the crimp ring passageway at the second end;

applying a crimping force to crimp the crimp ring to the crimp body at the one or more crimp features;

inserting the dual drop fiber optic cable and the crimp ring into a body passageway of a connector body, wherein the connector body comprises a first end, a second end, the body passageway extending from the first end to the second end, and at least one body aperture at the second end;

aligning the at least one body aperture of the connector body with the at least one crimp ring aperture of the crimp ring;

inserting at least one locking element into the at least one body aperture of the connector body and the at least one crimp ring aperture of the crimp ring to secure the connector body to the crimp ring; and

applying heat to the first heat shrink element to secure the connector body and the crimp ring to the dual drop fiber optic cable.

**22.** The method of claim **21**, wherein preparing the dual drop fiber optic cable comprises:

stripping a portion of the cable jacket to expose strength members and the sub-unit;

trimming a portion of the strength members;

stripping a portion of the sub-unit jacket and the sub-unit strength members to expose the tight buffer; and

stripping a portion of the tight buffer to expose the optical fiber.

**23.** The method of claim **21**, wherein the one or more crimp features are one or more indentations in the crimp body. 5

**24.** The method of claim **21**, wherein the body passageway comprises a buckle cavity.

**25.** The method of claim **21**, wherein the at least one locking element comprises at least one locking button comprising an insertion portion and a flange portion. 10

**26.** The method of claim **21**, wherein the strength members comprises glass yarn and tensile yarn.

**27.** The method of claim **21**, further comprising inserting the optical fiber into a ferrule assembly disposed within the body passageway. 15

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